

# Goniophotometric Test Report

## TEST ARTEFACT

light with lamp type of LED.

## MEASUREMENT METHOD

The measurements were made by a goniophotometer of type UNI 150. Goniometer was operated in horizontal axis. The DUT was rotated with 2-axis goniometer around the axes. The Luminous Intensity of the DUT at different directions were measured with a calibrated photometer located at a known far-field position of the DUT.

## MEASUREMENT UNCERTAINTY

The photometer of type SSL L200-016 is traceable to national standard at .The photometer head of type SED100-2997 is traceable to national standard at .

The power meter of type TDK GEN100-7.5 is traceable to national standard at .

The expanded uncertainties of the Luminous flux and efficacy are  $\pm 0.0\%$  and  $\pm 0.0\%$  ( $k = 2$ ), respectively.

## MEASUREMENTS

0.0000 and 0.0000, respectively.

### Table - Measurement information

Ambient temperature of the laboratory	25.0 degC
Power supply	35.9 Vac
Measurement distance	6833 mm
Location of the rotation axis (behind the outermost surface of the optics)	0 mm
Angular step, C plane	90.0 deg
Angular step, gamma angle	10.0 deg
Maximum gamma angle	90.0 deg
Stabilization time	30 min

### Table. Measurement results of the main luminous parameters

Luminous flux	Input power	Luminous efficacy	LOR	DWFF	Luminous intensity (g=0)
5581.3 lm	53.91 W	103.5 lm/W	100.0 %	100.0 %	1890 cd

### Table. Electrical parameters during the light measurements.

	Pin	PF	Vin	If
Value	53.91 W	1.000	35.93 V	1.500 A

St.dev.	0.00 %	0.00 %	0.00 %	0.00 %
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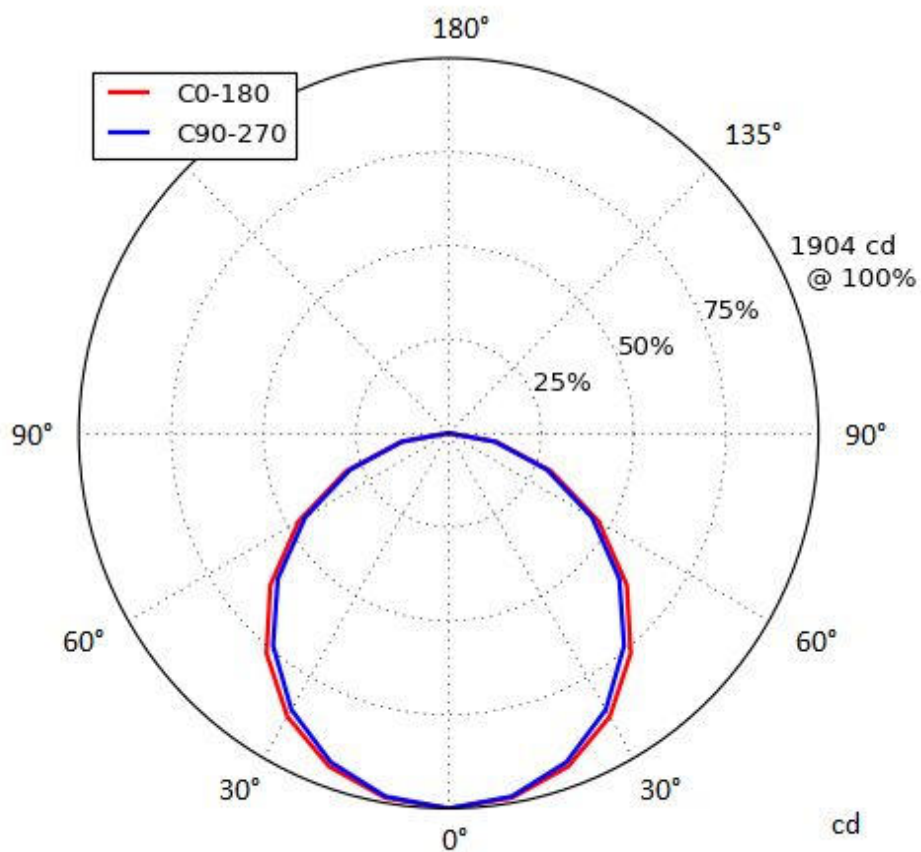
**Table. Maximum Luminous Intensity and its direction**

<b>Iv</b>	<b>g</b>	<b>C plane</b>
1904 cd	-0.0°	0.0°

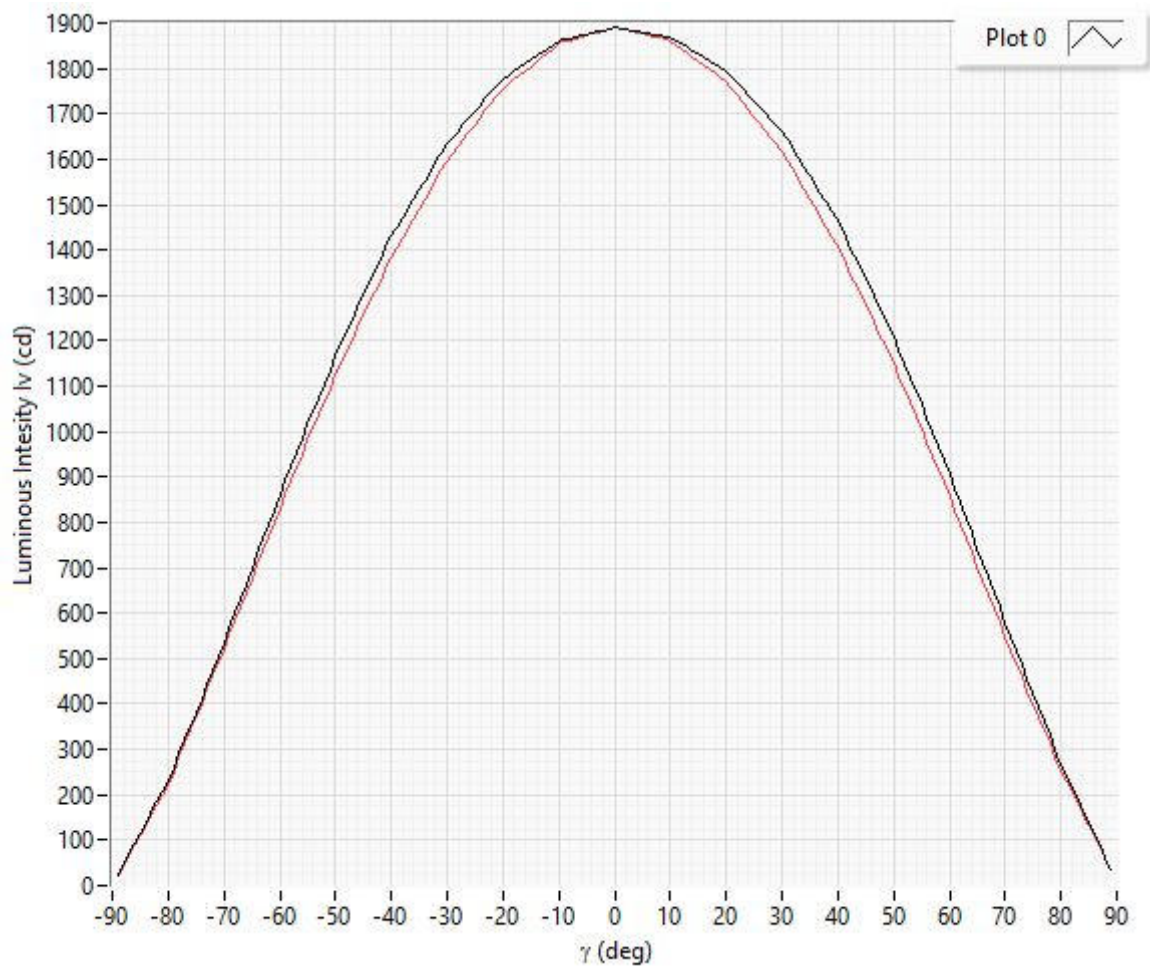
**Table. Beam widths at two perpendicular planes**

	<b>Beam angle, FWHM, 50 % (deg)</b>	<b>Beam angle, 10 % (deg)</b>	<b>Effective beam direction from g=0</b>
C0-180	116.0°	164.8°	-0.0°
C90-270	113.2°	164.3°	-0.0°

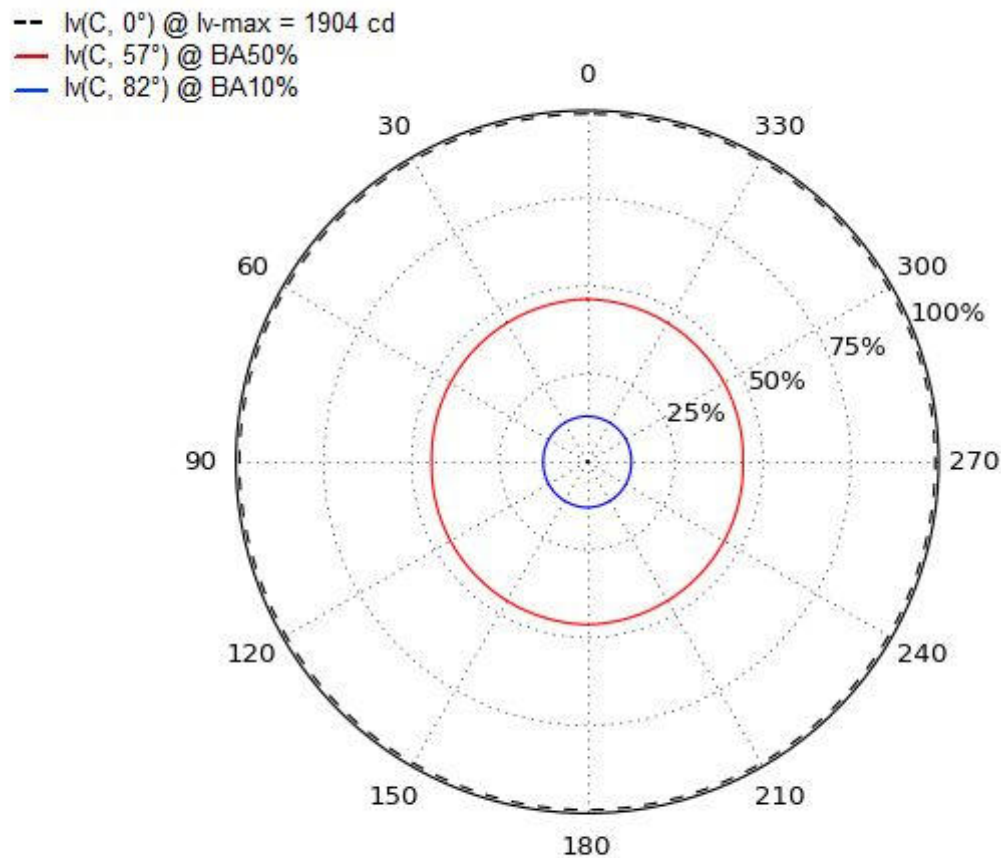
**Figure. Polar curve of the angular Luminous Intensity distribution at two perpendicular C planes and at C plane with maximum Luminous Intensity.**



**Figure. Luminous Intensity distribution in cartesian diagram at all measured C planes.**



**Figure. Isocandela as a function of C plane at gamma angle with maximum luminous intensity**



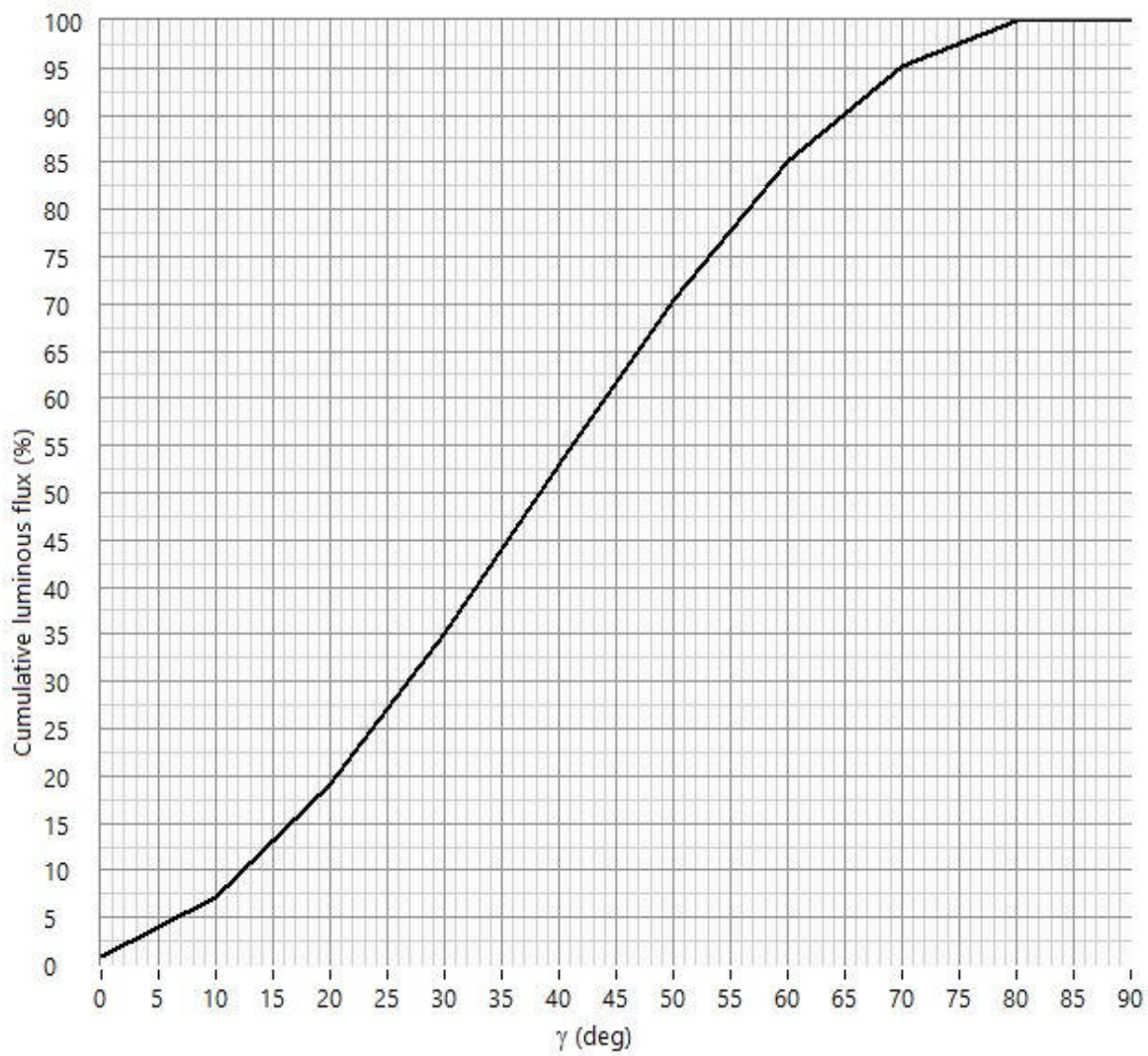
**Table. Zonal lumen summary**

	<b>Lumens</b>	<b>Relative lumens (%)</b>
0-20	1063.80	19.06
0-30	1955.20	35.03
0-40	2956.20	52.97
0-60	4753.20	85.16
0-80	5577.60	99.93
0-90	5581.30	100.00
10-90	5182.10	92.85
20-40	1892.40	33.91
20-50	2869.10	51.41
40-70	2358.70	42.26
40-90	2625.10	47.03
60-80	824.40	14.77
60-90	828.10	14.84
70-80	262.70	4.71
80-90	3.70	0.07
90-110	0.00	0.00
90-120	0.00	0.00
90-130	0.00	0.00
90-150	0.00	0.00
90-180	0.00	0.00
110-180	0.00	0.00
0-180	5581.30	100.00

**Table. Cumulative and Zonal luminous flux**

<b>gamma (deg)</b>	<b>Zone Flux (lm)</b>	<b>Sum Flux (lm)</b>	<b>Zone Flux (%)</b>	<b>Sum Flux (%)</b>
0.0	45.2	45.2	0.8	0.8
10.0	354.0	399.2	6.3	7.2
20.0	664.7	1063.8	11.9	19.1
30.0	891.3	1955.2	16.0	35.0
40.0	1001.0	2956.2	17.9	53.0
50.0	976.7	3932.9	17.5	70.5
60.0	820.4	4753.2	14.7	85.2
70.0	561.6	5314.9	10.1	95.2
80.0	262.8	5577.6	4.7	99.9
90.0	3.6	5581.3	0.1	100.0

**Figure. Cumulative luminous flux**





**Table. Luminance at different angles based on the defined luminous areas and measured luminous intensities.**

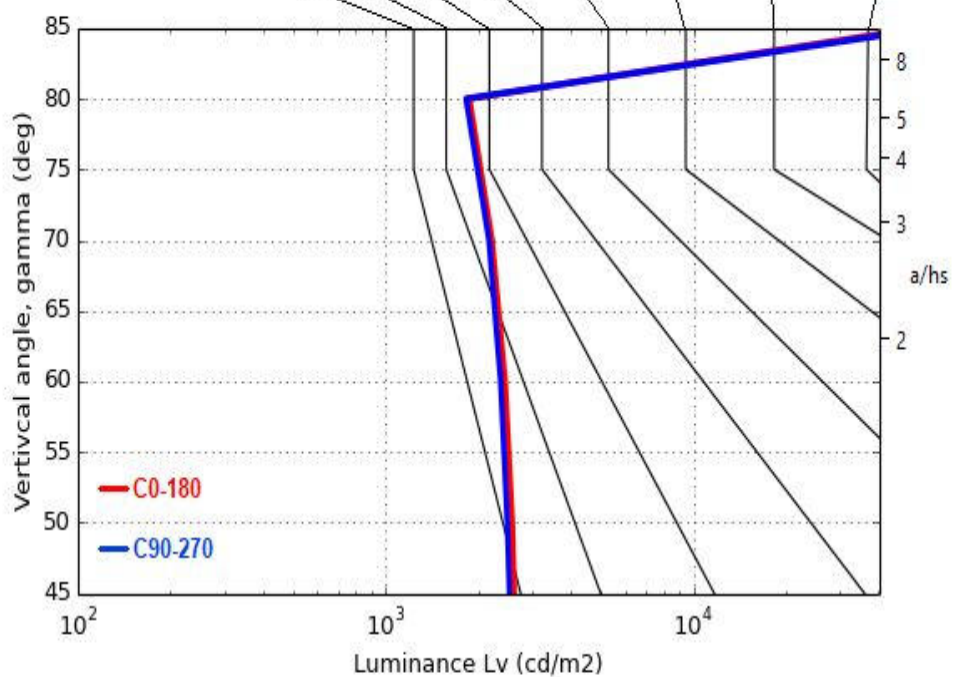
2688	0	2688
2613	0	2522
2515	0	2427
2347	0	2278
2096	0	2046
1880	0	1834

**UGR table (CIE 190)**

Ceiling		70	70	50	50	30	70	70	50	50	30
Walls		50	30	50	30	30	50	30	50	30	30
Floor		20	20	20	20	20	20	20	20	20	20
Room size		Viewing direction at right angles to lamp axis					Viewing direction parallel to lamp axis				
	X Y										
2H	2H	15.5	17.1	15.8	17.5	17.8	15.3	17.0	15.7	17.3	17.6
	3H	17.3	18.9	17.7	19.2	19.5	17.1	18.7	17.5	19.0	19.3
	4H	18.1	19.5	18.5	19.8	20.2	17.9	19.3	18.3	19.6	20.0
	6H	18.6	20.0	19.0	20.3	20.7	18.4	19.7	18.8	20.1	20.5
	8H	18.8	20.1	19.3	20.5	20.9	18.6	19.9	19.1	20.3	20.7
4H	12H	19.0	20.2	19.4	20.6	21.0	18.8	20.0	19.2	20.4	20.8
	2H	16.1	17.5	16.5	17.9	18.3	16.0	17.4	16.4	17.7	18.1
	3H	18.2	19.4	18.6	19.8	20.2	18.0	19.2	18.5	19.6	20.0
	4H	19.1	20.2	19.5	20.6	21.0	18.9	20.0	19.3	20.4	20.8
	6H	19.8	20.7	20.2	21.2	21.6	19.6	20.5	20.0	21.0	21.4
8H	8H	20.0	20.9	20.5	21.4	21.8	19.9	20.7	20.3	21.2	21.6
	12H	20.3	21.1	20.7	21.5	22.0	20.1	20.9	20.6	21.3	21.8
	4H	19.4	20.3	19.9	20.7	21.2	19.3	20.1	19.7	20.6	21.1
	6H	20.2	21.0	20.7	21.5	21.9	20.1	20.8	20.6	21.3	21.8
	8H	20.6	21.2	21.1	21.8	22.2	20.4	21.1	20.9	21.6	22.1
12H	12H	20.9	21.5	21.4	22.0	22.5	20.8	21.3	21.3	21.8	22.4
	4H	19.4	20.2	19.9	20.7	21.2	19.3	20.1	19.8	20.6	21.0
	6H	20.3	21.0	20.8	21.4	22.0	20.2	20.8	20.7	21.3	21.8
	8H	20.7	21.3	21.2	21.8	22.4	20.6	21.2	21.1	21.7	22.2

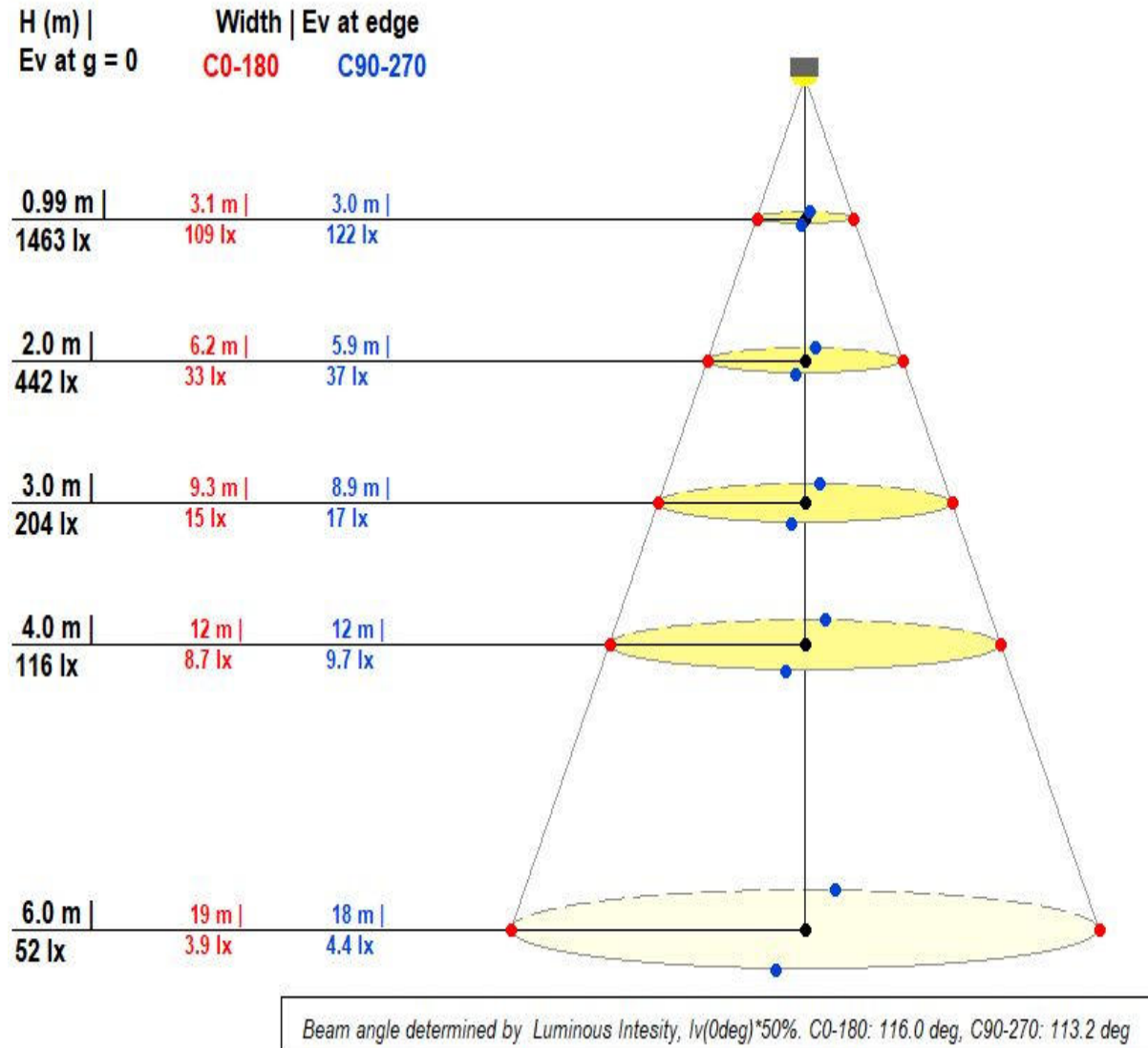
**Söllner diagram (EN 12464)**

LCS index	Illuminance on Working Plane (lx)							
A	2000	1000	500	<300				
B		2000	1000	500	<300			
C			2000	1000	500	<300		
D				2000	1000	500	<300	
E					2000	1000	500	<300
Graph	a	b	c	d	e	f	g	h

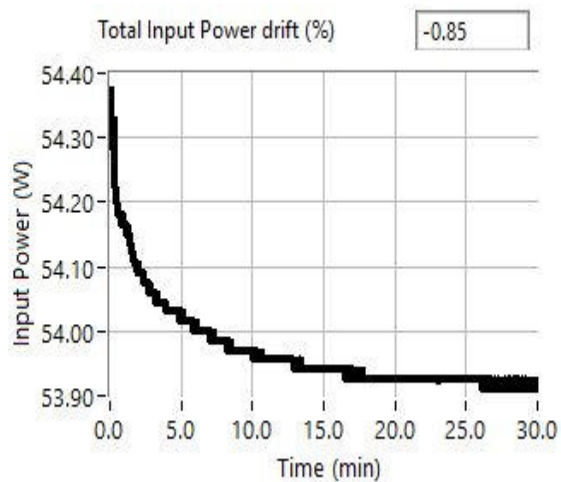
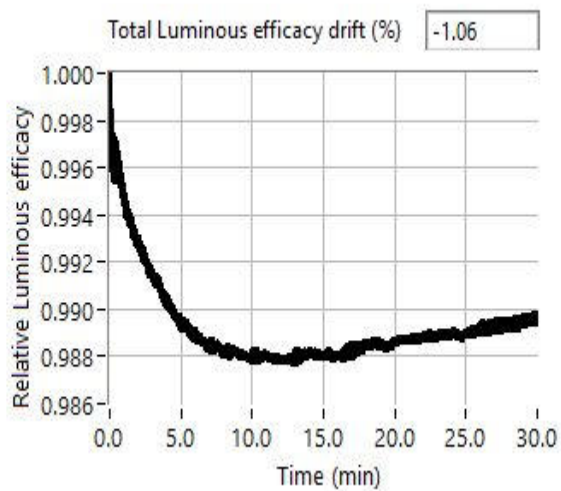
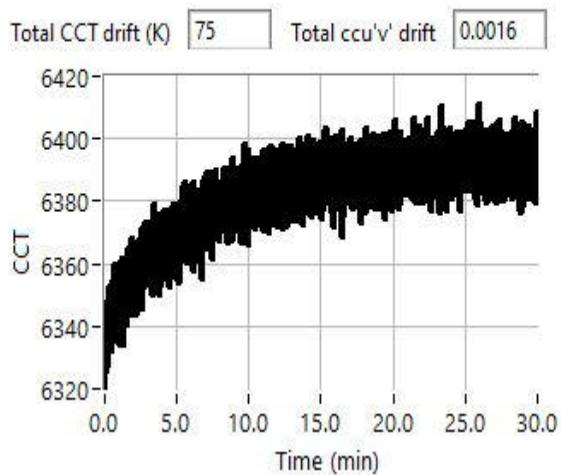
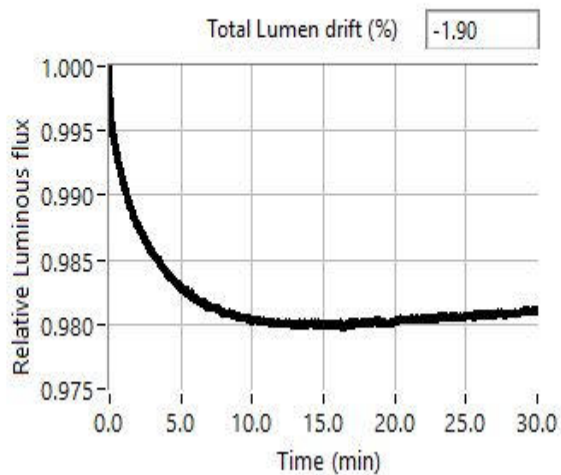


### CONE DIAGRAM

- Cone is limited by the beam angle at the planes of C0 and C90
- H = Mounting Height
- D = Cone diameter
- Ev Edge = Illuminance at the edge of the cone of the C0/90 plane
- Ev Center = Illuminance at the center of the cone



Stabilization time (min) 30



# Goniocolorimetric Test Report

## MEASUREMENT METHOD

The measurements were made by a goniospectrophotometer at the dark room of SSL Resource Ltd. The spectral radiant intensities of a light source at different directions were measured with a calibrated spectrometer located at a known distance from the light source.

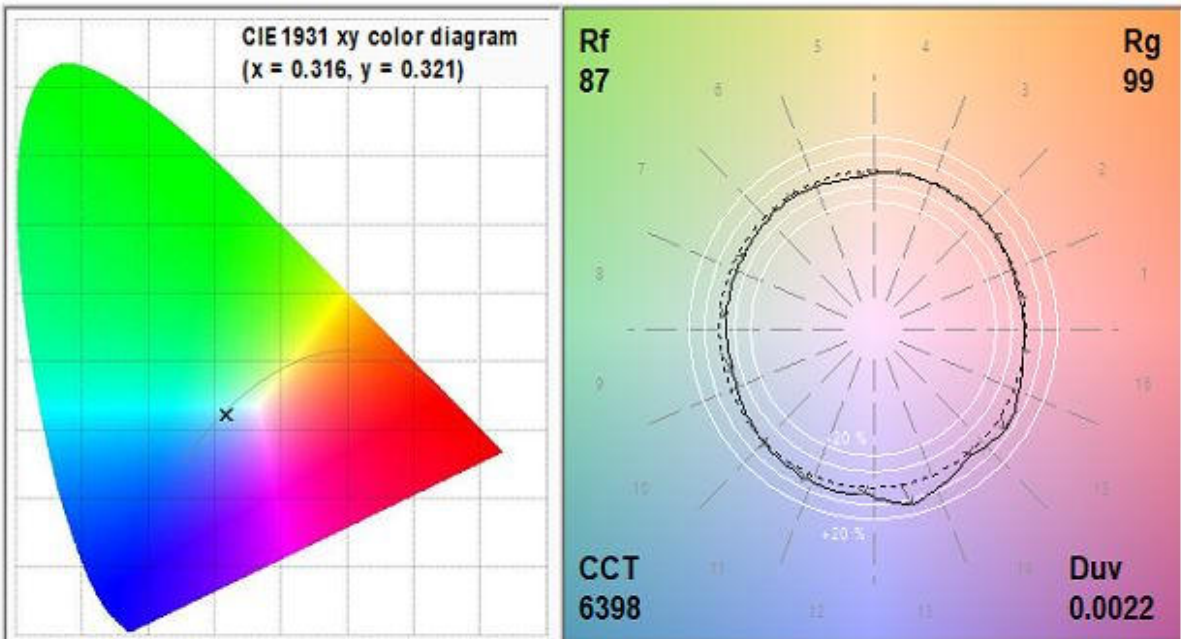
## MEASUREMENT UNCERTAINTY

The spectroradiometer (SSL S-880, sn SM245-QU0P5514-EU) used in goniophotometer is traceable to national standard of spectral irradiance responsivity at VTT-MIKES (Certificate of calibration T-R 1159 signed on 16.3.2021, internal calibration certificate C-R 0209). The expanded measurement uncertainties of the luminous flux are  $\pm 5\%$  ( $k = 2$ ).

## Table - Measurement information

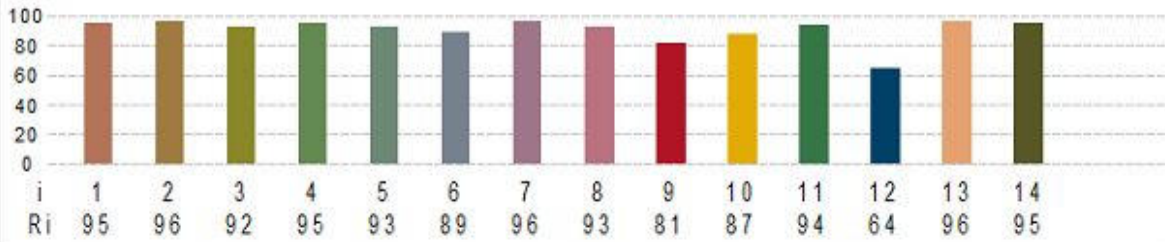
Ambient temperature of the laboratory	25.0 degC
Power supply	35.9 Vac
Measurement distance	2480 mm
Location of the rotation axis	0 mm
Angular step, C plane	90.0 deg
Angular step, gamma angle	10.0 deg
Maximum gamma angle	30.0 deg
Stabilization time	30 min

# GonioSpectroRadiometric Test Report



**Ra (R1-R8) = 94**

Special color rendition index CRI Ri 1-14

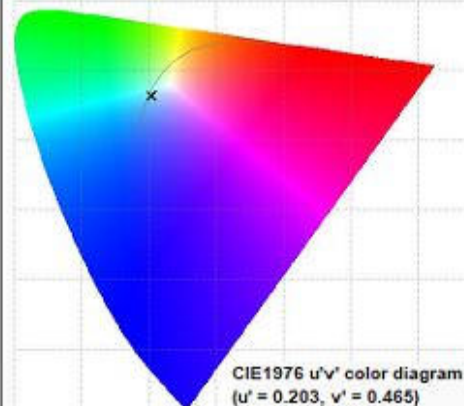
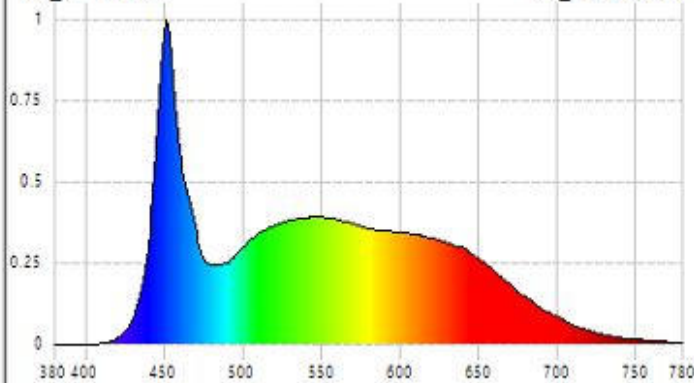


Fidelity indices Rf of the 16 hue bins



$\Phi_v = 1931 \text{ lm}$

$\Phi_e = 7820 \text{ mW}$



**Table - Measurement results of the total colorimetric parameters**

Color coordinates in CIE 1931 diagram	x,y	(0.3156, 0.3214)
Color coordinates in CIE 1976 diagram	u',v'	(0.2028, 0.4647)
Correlated color temperature	CCT	6398 K
General color rendering index	CRI, Ra	93.6
Spatial color uniformity	SDCM	0.8
Distance from Planckian locus	Duv	0.0022
Color Consistency	SDCM	0.0
Dominant Wavelength	nm	482.6
Excitation purity	%	6.9

*Weighted average of the angular color measurements. --SDCM = Maximum deviation of the angular u', v' measurements from the weighted average. -- SDCM corresponds 1-step MacAdam Ellipse, 1 SDCM corresponds to u'v' = 0.001*

**Table - Total special color rendering indeces**















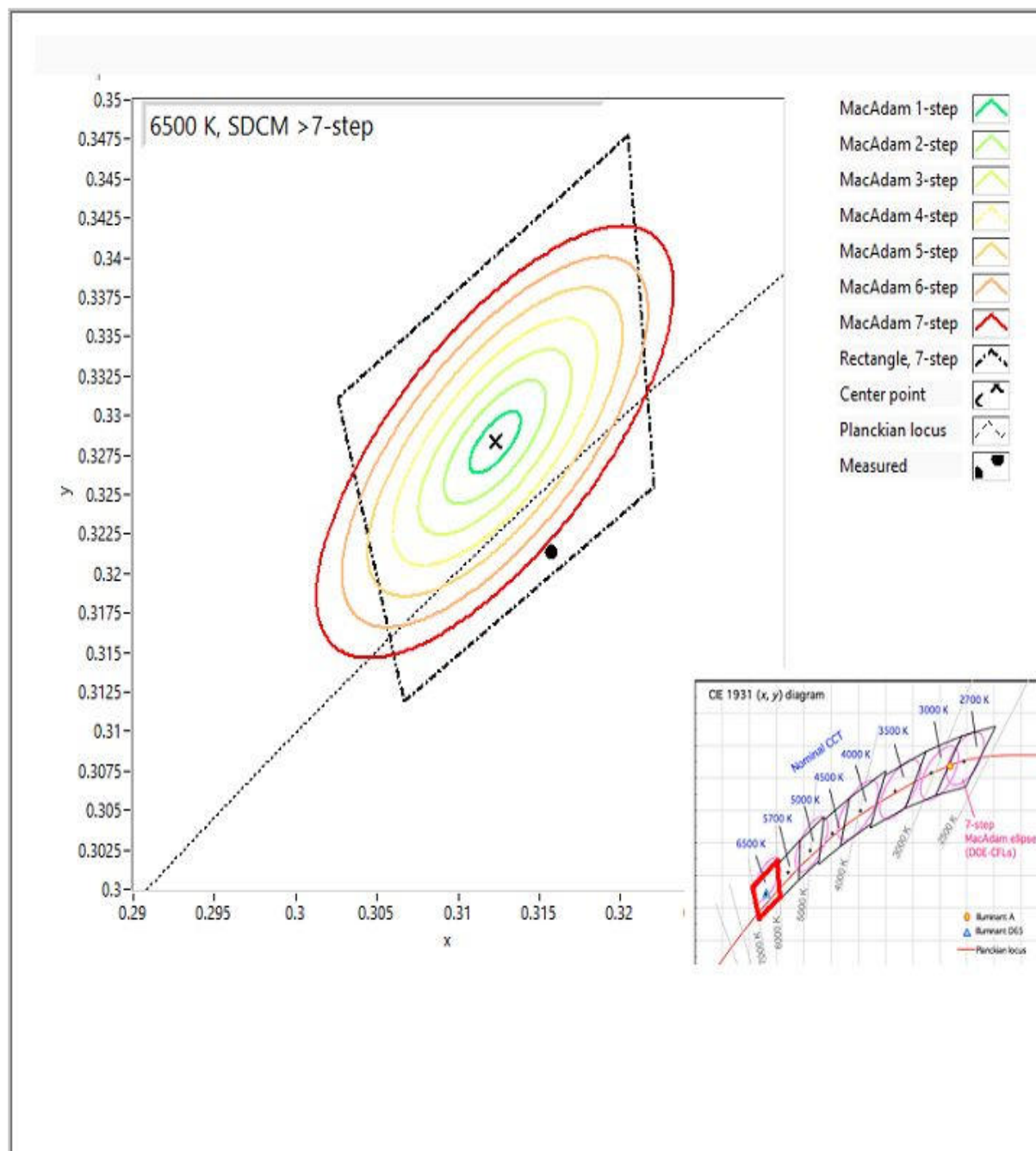
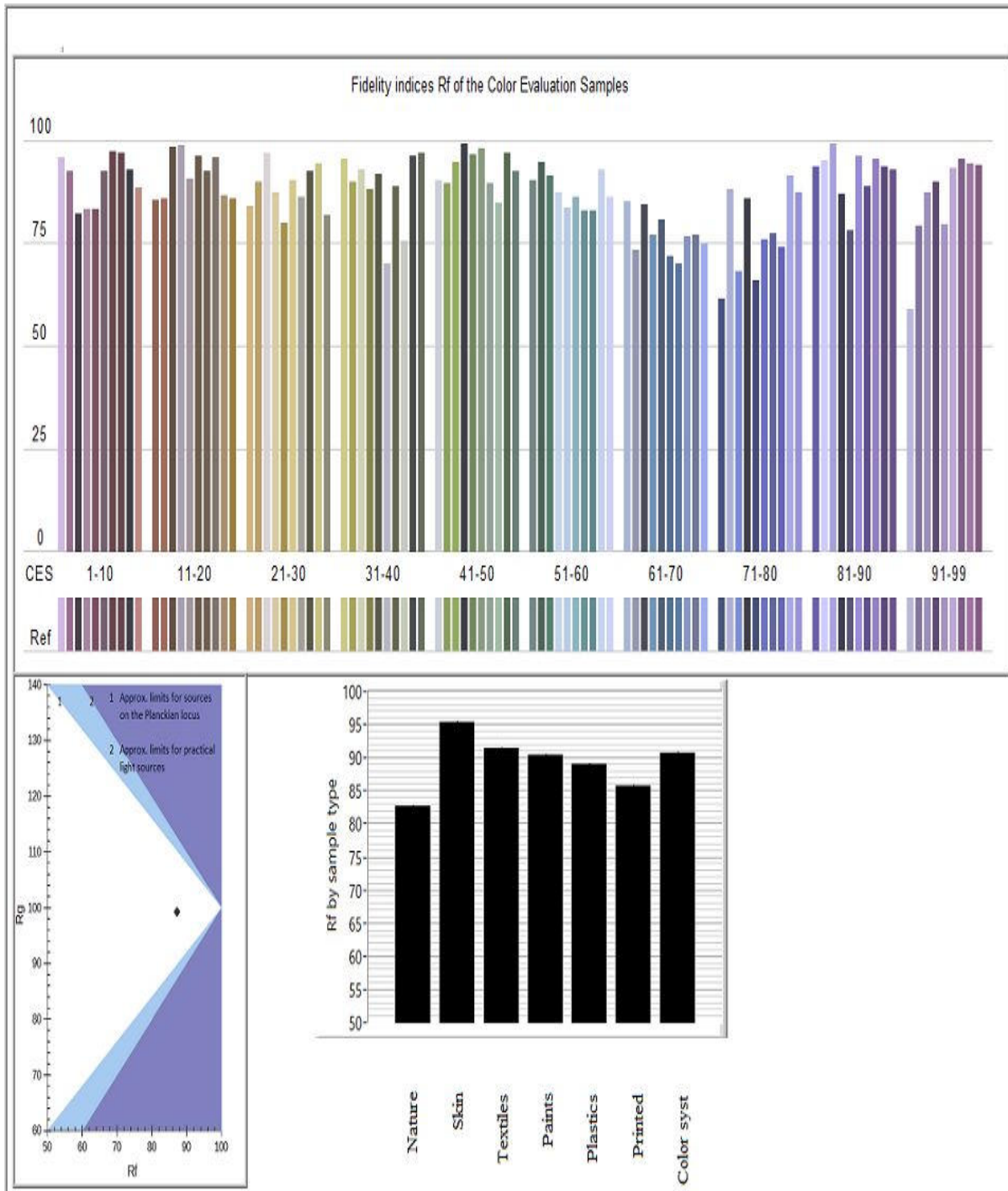
R1	R2	R3	R4	R5	R6	R7	R8	R9	R10	R11	R12	R13	R14
95.1	95.8	92.0	94.6	93.2	89.2	96.0	93.2	80.9	87.3	94.0	64.3	96.4	95.4
													



Figure - Color classification and MacAdam ellipse / SDCM ANSI C78.377



**Table - Color rendition details according to TM30-18**



**Table - Results of the absolute spectral distribution measurement**

Luminous Flux	F	1931.1 lm
Electrical Power	Pel	53.9 W
Optical Power	Popt	7.82 W
Thermal Power	Pth	46.09 W
Luminous Efficacy	LPW	35.8 lm/W

Luminous Efficacy of Spectrum	LER	247 lm/W
Wall-Plug Efficiency	WPE	14.5 %
Photosynthetic Photon Flux	PPF	34.8 $\mu\text{mol/s}$

**Table - Color coordinates u'v' at different angles in CIE1976 color diagram**

C-plane	gamma	u'	v'
0	-30.0	0.2034	0.4652
0	-20.0	0.2029	0.4649
0	-10.0	0.2026	0.4645
0	0.0	0.2025	0.4644
180.0	30.0	0.2032	0.4650
180.0	20.0	0.2029	0.4648
180.0	10.0	0.2026	0.4647
180.0	0.0	0.2025	0.4646
90	-30.0	0.2026	0.4642
90	-20.0	0.2025	0.4644
90	-10.0	0.2024	0.4644
90	0.0	0.2024	0.4646
270.0	30.0	0.2026	0.4645
270.0	20.0	0.2025	0.4645
270.0	10.0	0.2025	0.4644
270.0	0.0	0.2024	0.4644

Figure - Spatial color uniformity in CIE1976 diagram

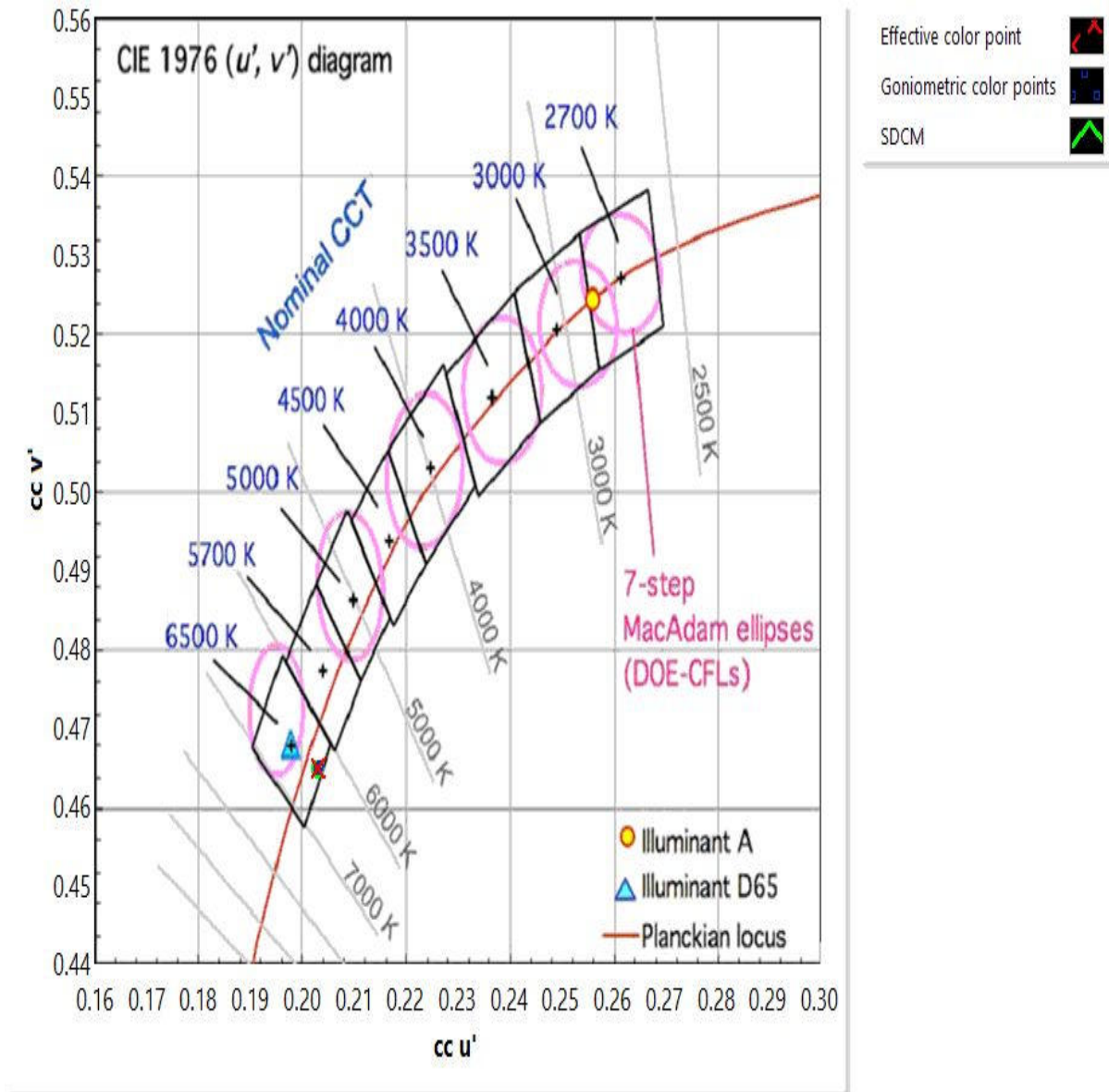
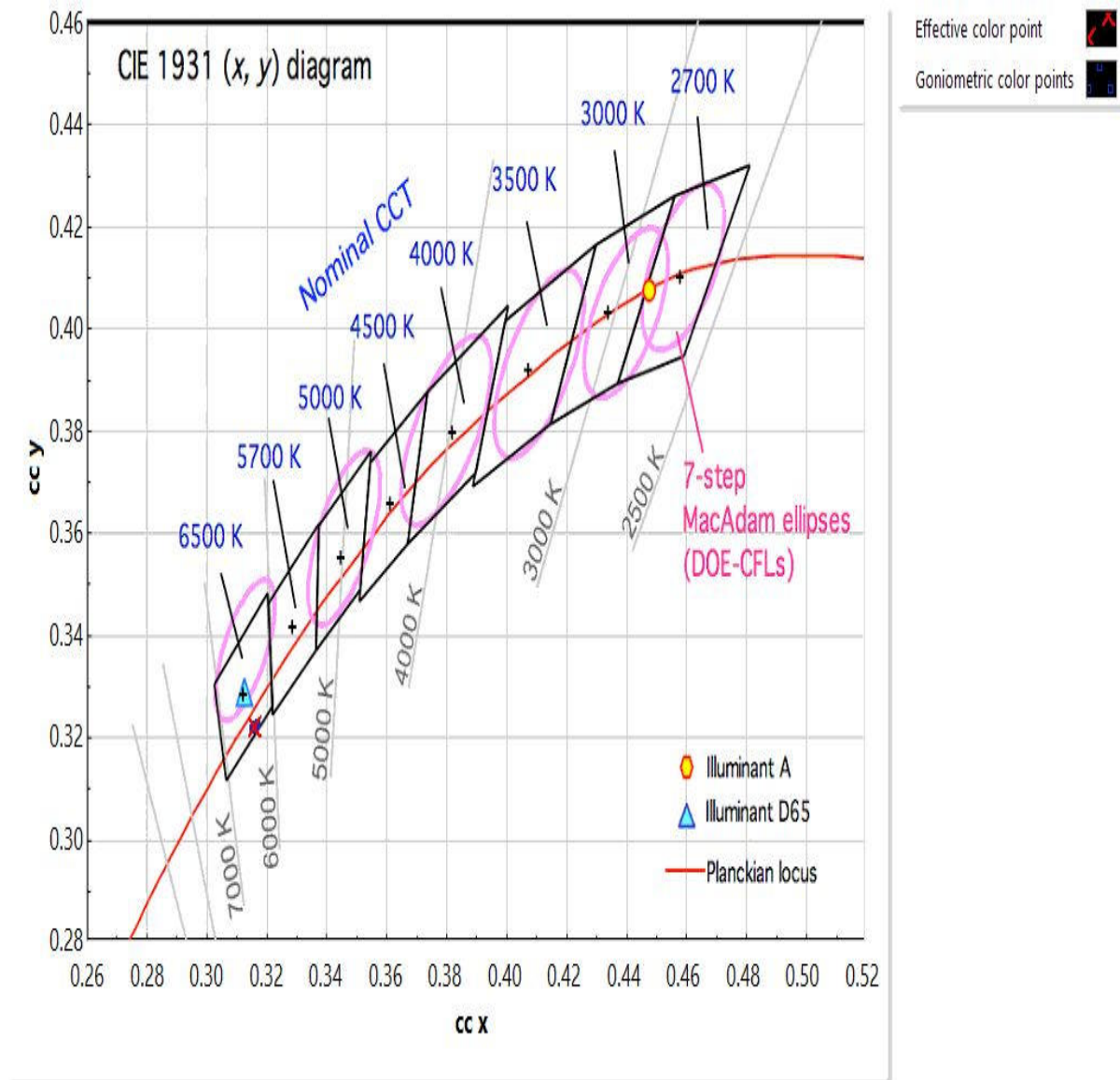


Figure - Spatial color uniformity in CIE1931 diagram



**Figure. Total Spectral Radiant Flux**

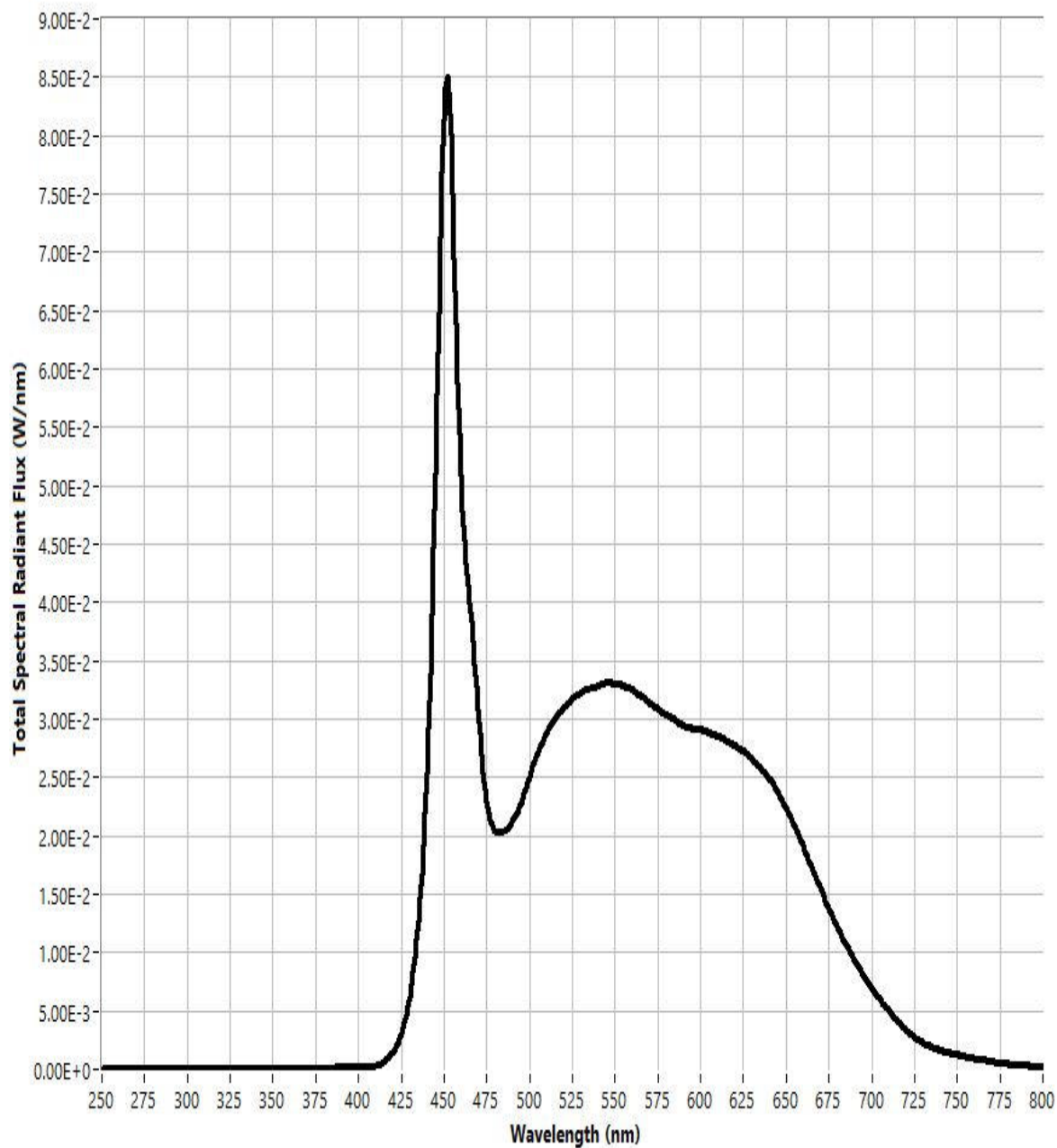


Figure - Normalized spectrum at different angles

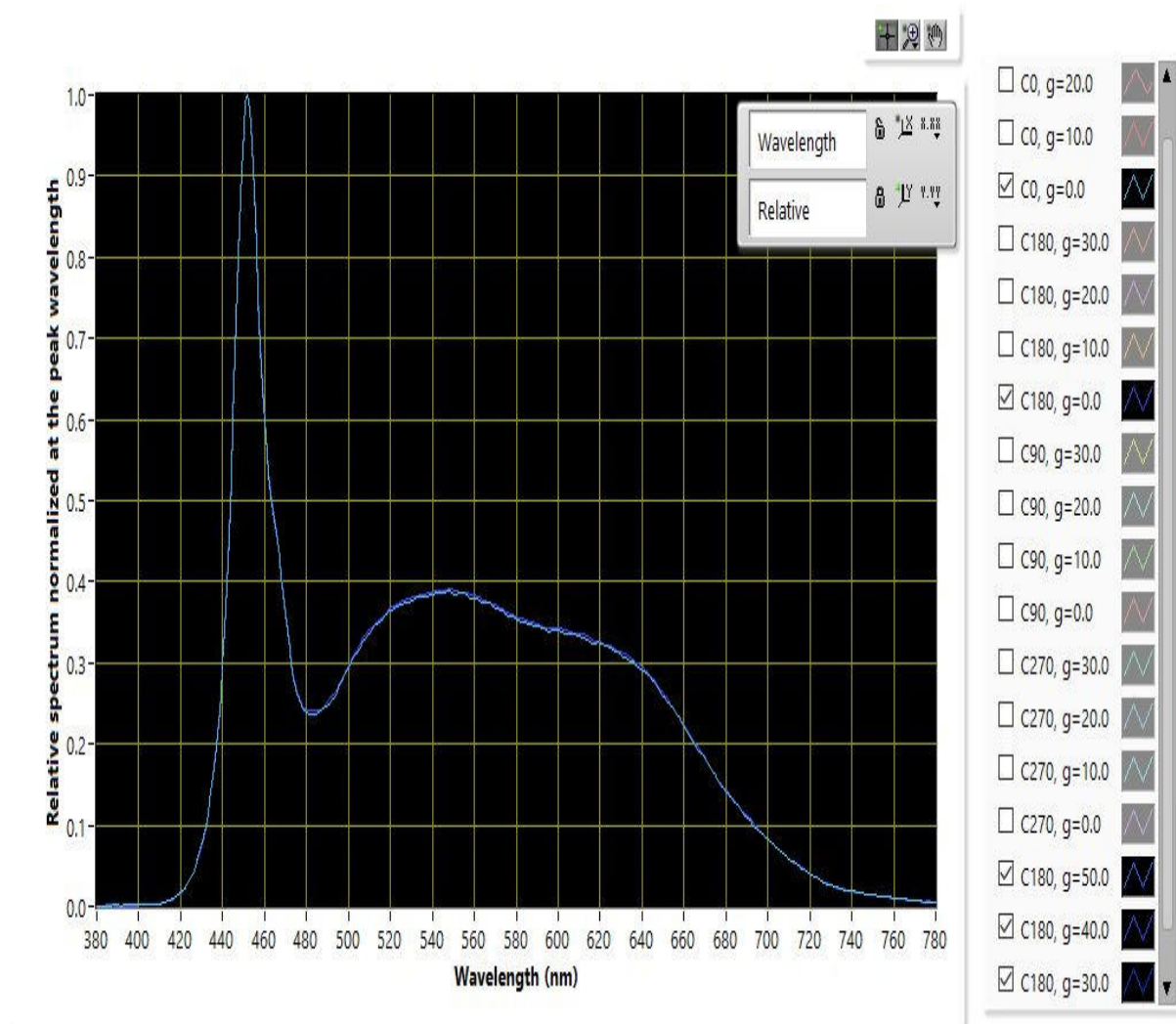




Figure - CCT as a function of angle

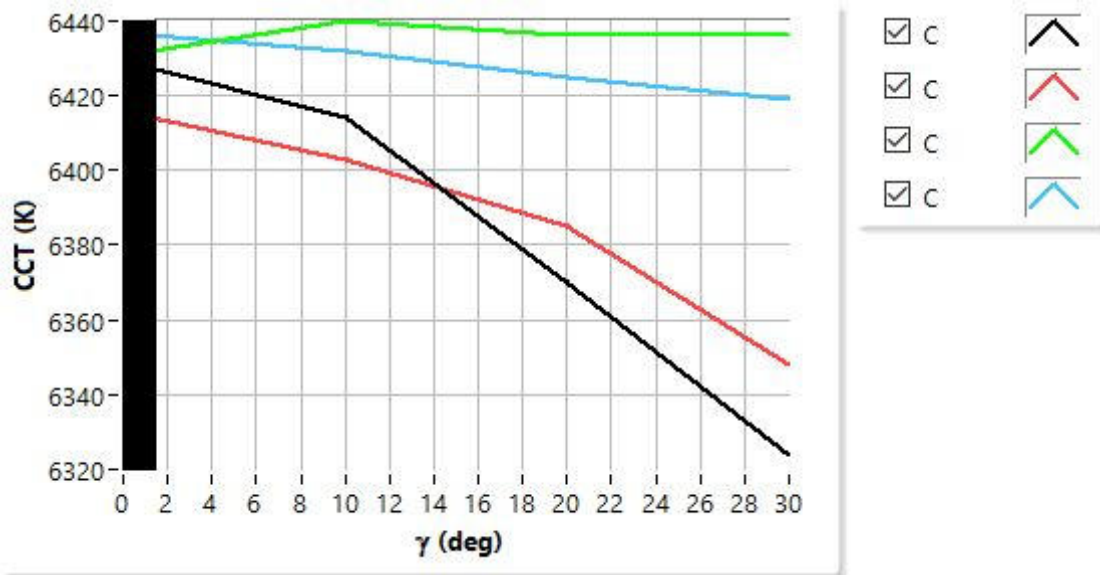


Figure - CRI, Ra as a function of angle

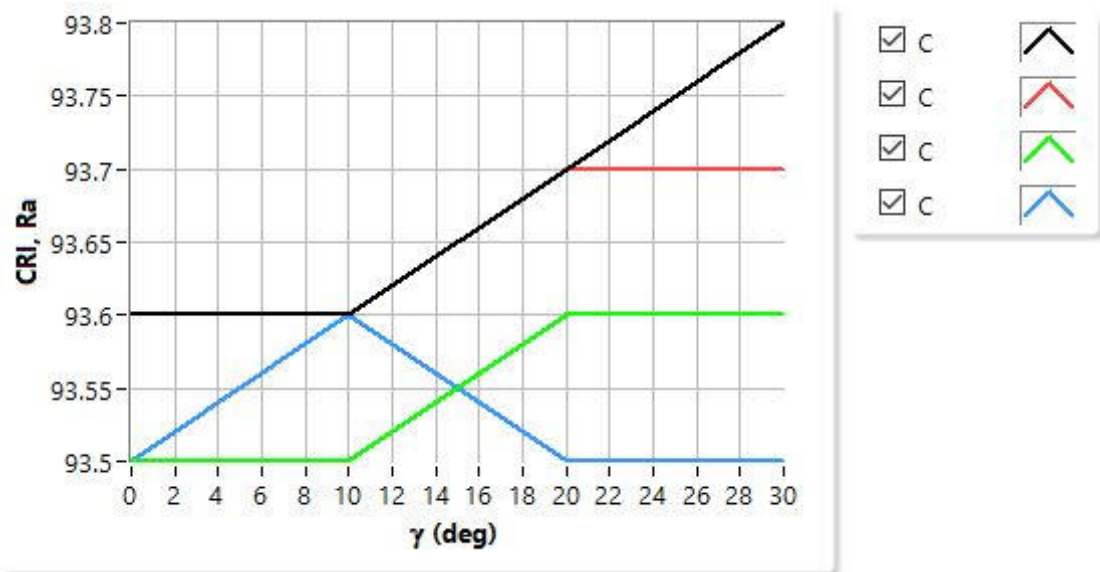


Figure - Peak WL as a function of angle

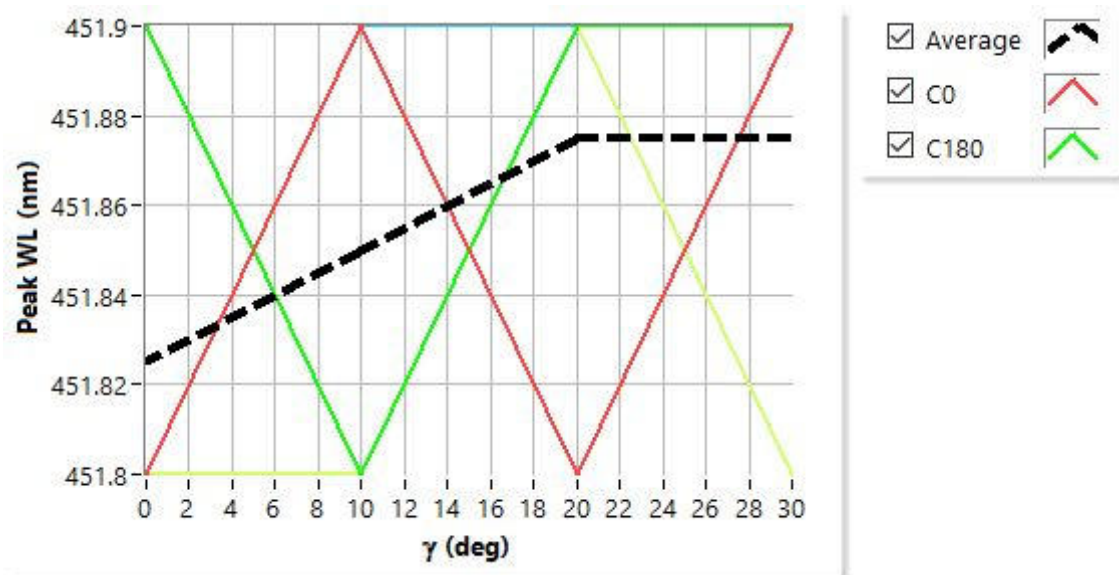


Figure - FWHM bandwidth as a function of angle

